YOUTH CORNER

Cobalt Exposure: Health Risks and Environmental Impact Assessment in Lawton, Oklahoma

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The article *Cobalt toxicity in humans—A review of the potential sources and systemic health effects* by Lesseyens et al., 2017 focuses on the toxicity of cobalt in humans. Cobalt (Co) is a natural metal element with similar properties to iron and nickel. Cobalt is classified as a trace element; it is essential for nutrition (e.g a constituent of vitamin B12). The pros of exposure to cobalt in humans include "the prevention of nutritional deficiencies, the functioning of the immune system, the regulation of gene expression, the antioxidant defense, and the prevention of chronic diseases'' (Lesseyens et al., 2017). The primary benefit provided by Co (i.e. via ingestion or inhalation) is that cobalt is also used in industrial applications such as the production of hard metals, grinding, mining, as well as painting. Exposure to cobalt typically originates from consumption which can lead to erythrocytosis.

In the paper, *Future Availability of Cobalt: Predicting Future Production and the Possible Impact of Environmental, social, and Governance Conflicts on Cobalt Production,* it is stated that there had been a huge increase in the demand for cobalt due to the rise of electric cars. However, this can impact the environment. According to Varlet, 2023, the study highlights the potential for the exploration of new cobalt reserves, which could significantly impact future production trajectories from terrestrial deposits and underwater resources. A human biomonitoring study was conducted to analyze the exposure of metals such as cobalt in humans.
This study was conducted in Katanga, Democratic Republic (DR) of Congo due to it being the region that supplies the world with the majority of Co. The extraction of cobalt in this area has affected both the environment and the humans that reside in Katanga. The residue of the mining is said to expose "secondary oxidized copper (Cu) and Co ore in thick surface deposits (De Putter et al., 2010, Decrée et al., 2010); and huge masses of tailings and large tracts of unprotected polluted soils." This has contaminated the surface of the soil with Cobalt to such an intense degree that it has negatively altered the compositions of the natural plants. The human biomonitoring study of metal exposure

showed the significance of high concentrations of Cobalt in the urine of both children and adults. (Banza, et al., 2009) The concentrations were higher in this region of Cobalt when compared with the general region/ population. Some of the non-polluted areas of Katanga showed exposure to cobalt, however, the exposure came from the consumption of food/plants. As stated above plants can be altered in the soil and once consumed transmit cobalt to the body of the consumer. Drinking from contaminated water sources can also contribute to the exposure of cobalt as well as the consumption of fish from the source.

From the study, samples of water and fish were collected from the polluted Lufira River and Tshangalele Lake, downstream of an intensive mining and refining site in DR. Congo. The "concentrations in river and lake water ranged 1– > 500 μg Co/L and Co in the commonly consumed tilapia fish (*Oreochromis macrochir*) exceeded 30 μg/g dry weight in contaminated rivers, i.e. about 30-fold above a background value found upstream of the pollution source" (Banza et al., 2009) The pollution has affected the health of miners as well. The overall state of health among miners and communities is extreme. There is reduced life expectancy, higher infant mortality rate, and higher prevalence rate of HIV, diarrhea, hepatitis, meningitis, bilharziasis, cholera, typhoid, tetanus, typhus, malaria, yellow fever, tuberculosis, musculoskeletal disorders, respiratory disorders, and headaches (Tsurukawa et al., 2011).

Lawton, Oklahoma

The first U.S. cobalt refinery, Westwin Elements, was approved in the summer of 2023. Due to the increasing cobalt demand, Westwin Elements is a private company that seeks to build America's only commercial-scale cobalt metal refinery in Oklahoma. The impact of the cobalt factory has its pros and cons. Some pros that the company of Westin has asserted include the utilization of a cobalt refining method to minimize the impact on air, water, and soil and also commercializing carbonyl refining, which is environmentally neutral with no harm to air, water, and soil (Rare earth reports, n.d) The possible negative impacts of the refinery include potential hazards to the environment and the human body. (i.e chronic diseases, reproductive hazards, cancer hazards, and acute health effects). Most questions regarding the effects of Co stem from the community and population that reside in Lawton, OK. The majority of the questions have yet to be answered by Westwin. With Westwin being entirely new to the refinery industry, community members are concerned about the dangers that could occur from Westwin's inexperience with toxic elements.

Furthermore, the company is building on lands sacred to the Commanche people. (Belgard, 2024) Listed are some of the major concerns of the Commanche, Apache, and Kiowa who reside in Lawton. What are the effects of this refinery on the land, agriculture, cattle, livestock, wildlife, water, and the air? What are the effects of cobalt on health issues such as breathing and the causing of Cancer, will this harm the growth of children and the expectant mothers? Will this harm the unborn and the elderly?"(Oklahoma, 2024) According to the Centers for Disease Control and Prevention, cobalt exposure presents risks to the environment and human health, potentially leading to cancer and detrimental effects on the eyes, skin, heart, and lungs. This demonstrates the likelihood of pollution stemming from the proposed factory. While the specific impacts have yet to be observed as the refinery is still under construction, insights from nations with existing cobalt refinery operations suggest that the consequences will likely be unfavorable for both the land and the local community.

Mitigation

Monitoring the health of individuals and the environment subjected to cobalt exposure involves implementing comprehensive and multifaceted strategies. This will help combat the risk of environmental and health detriments if Westwin's promises are ineffective and commercializing carbonyl refining falls through. Some environmental factors include soil and water testing, air quality monitoring, and biodiversity and ecosystem health assessments. To elaborate on soil and water testing, initiating periodic sampling and analysis of soil and water in areas surrounding cobalt-emitting industries to detect contamination levels. The implementation of remediation strategies once elevated cobalt levels are detected in the environment include, phytostabilisation, phytoextraction, and rhizofiltration (i.e. the use of plants to absorb dangerous elements). These are some of the techniques/bioremediation strategies used worldwide to reduce cobalt in the fields (Mahey et al., 2020). "Cobalt should be readily removed by most conventional water treatment processes, especially those involving sedimentation or adsorption.
Some pre-oxidation to Cobalt's +3 oxidation state may be necessary should be readily achieved"(Nagpal et al., 2004). Westwin can also install air quality monitoring stations around industrial sites to continuously measure cobalt concentrations in the air. The use of portable air sampling devices for regular checks in various locations would help reduce the amount of air pollution. Other regulations and measures to reduce cobalt exposure include the implementation of stricter controls and standards in areas with significant cobalt use or production.

Effective standards for workers/miners include engineering controls and enclosed/isolated operations or providing local exhaust ventilation at the site of chemical release (OSHA, 1998). Conducting comprehensive risk assessment management plans to identify potential sources of exposure along with launching various public health initiatives such as offering medical care and screening to the residents of Lawton to reduce the health risks associated with exposure to cobalt. The long-term effects of cobalt on individuals' health include asthma-like allergies, skin allergies, and effects on the heart, lungs, thyroid, liver, and kidneys. It is also deemed a carcinogen (OSHA, 1998). Offering early medical screenings would help identify if an individual is exposed while reducing the risk of long-term effects on human health. Stakeholders are key to public health initiatives. Engage stakeholders through collaborations with government agencies, public health organizations, and community groups to develop and implement monitoring programs.

Cost Estimation

Investing in comprehensive monitoring and mitigation strategies for cobalt exposure involves highly cost-effective plans, however, this will be imperative for long-term economic and public health benefits. For instance, one of the long-term effects of cobalt is respiratory diseases such as Asthma. "The total annual cost of asthma in the United States, including medical care, absenteeism, and mortality, was $81.9 billion and the annual per-person medical cost of asthma was $3266" (*The Economic Impact That Asthma Has on the Economy and Families*, n.d.). Early detection and regular medical screenings can prevent the onset of severe health issues as well as reduce long-term healthcare costs for individuals and the community. By addressing issues early, Lawton, Oklahoma, can effectively manage cobalt exposure and safeguard public health and the environment.

References

Banza, C., Nawrot, T. S., Haufroid, V., Decrée, S., De Putter, T., Smolders, E., Kabyla, B. I., Luboya, O. N., Ilunga, A., Mutombo, A. M., & Nemery, B. (2009). High human exposure to cobalt and other metals in Katanga, a mining area of the Democratic Republic of Congo. *Environmental Research*, *109*(6), 745–752. https://doi.org/10.1016/j.envres.2009.04.012

Belgard, N. S. (2024, February 29). *Cobalt Refinery to break ground on Kiowa, Comanche, Apache homelands*. Indigenous Peoples Power Project. https://www.ip3action.org/cobalt-refinery-to-break-ground-on-kiowa-comanche-apache-homelands/

Leyssens, L., Vinck, B., Van Der Straeten, C., Wuyts, F. L., & Maes, L. (2017). Cobalt toxicity in humans—A review of the potential sources and systemic

health effects. *Toxicology*, *387*, 43–56. https://doi.org/10.1016/j.tox.2017.05.015

Mahey, S., Kumar, R., Sharma, M., Kumar, V., & Bhardwaj, R. (2020). A critical review on toxicity of cobalt and its bioremediation strategies. *SN Applied Sciences/SN Applied Sciences*, *2*(7). https://doi.org/10.1007/s42452-020-3020-9

Nagpal, N. K., Section, B. C. W. P., Associates, G., & Protection, B. C. M. O. W. L. a. A. (2004). *Ambient Water quality guidelines for Cobalt: Overview*. https://www.dwqr.scot/media/zs3fzvs1/pws-parameter-information-cobalt.pdf

Noël, L., Chekri, R., Millour, S., Vastel, C., Kadar, A., Sirot, V., Leblanc, J., & Guérin, T. (2012). Li, Cr, Mn, Co, Ni, Cu, Zn, Se and Mo levels in foodstuffs from the Second French TDS. *Food Chemistry*, *132*(3), 1502–1513. https://doi.org/10.1016/j.foodchem.2011.12.009

Oklahoma, N. (2024, February 6). Comanche Nation passes historic resolution opposing proposed Westwin Elements Cobalt-Nickel refinery in Lawton, Oklahoma. Native Oklahoma. https://www.nativeoklahoma.us/comanche-nation-passes-historic-resolution-opposing-pr*oposed-westwin-elements-cobalt-nickel-refinery-in-lawton-oklahoma/*

OSHA. (1998). COBALT. https://nj.gov/health/eoh/rtkweb/documents/fs/0520.pdf

Rare Earths report. (n.d.). Economic Security Council. https://www.economicsecuritycouncil.org/rare-earths-report.html

The economic impact that asthma has on the economy and families. (n.d.). https://cms.illinois.gov/benefits/stateemployee/bewell/financialwellness/economic-impact -of-asthma.html#:~:text=The%20annual%20per%2Dperson%20medical,emergency%20department%20(ED)%20care.

Tsurukawa, N., Prakash, S., Manhart, A., & Öko-Institut e.V. (2011). *Social impacts of artisanal cobalt mining in Katanga, Democratic Republic of Congo*. http://resourcefever.com/publications/reports/OEKO_2011_cobalt_mining_congo.pdf

Varlet, M. (2023). Future availability of cobalt: Predicting future production and the possible impact of environmental, social, and governance conflicts on cobalt production. DIVA. https://www.diva-portal.org/smash/record.jsf?pid=diva2%3A1768110&dswid=9143